

many as possible of the American republics to the south, and, of course, the contiguous territory of Canada and British America on the north. The size of the map was limited to 19 by 24 inches, and the territory actually included is from 10° to 55° north latitude (about 3,000 miles), and from 45° to 130° west longitude (about 4,200 miles), or over 12,000,000 square miles, the largest section of the earth's surface ever covered by a single synoptic weather chart made up from telegraphic observations. This map was engraved with the utmost care and printed in two harmonious tints of brown and green. Copies of the blank chart can be furnished to students of meteorology.

(b) *Weather forecasts and map printing.*—For the preparation of this map daily telegraphic reports are required from over 165 stations. These reports, passing over the regular telegraphic circuits, are received, translated, and tabulated at the down-town Weather Bureau office in Buffalo, and, as soon as the regular issue of maps has been printed, proofs, etc., are sent to the Weather Bureau Exhibit at the Exposition Grounds, four miles distant. Here the lines and data are rapidly transferred to stone for the printing of the souvenir edition on the large map described above. The exhibit is equipped with a telephone in connection with the city office, and while the small city maps are being prepared and printed, all data that can be transmitted in this manner, including the daily forecasts, etc., are rapidly passing over the line to the official in charge of the exhibit so that everything is ready for the transfer of the lines and tabular data when these are received. In this way the telegraphic observations taken at the 165 stations scattered over this vast extent of territory at 8 a. m., seventy-fifth meridian time, are being printed in colors (black and red) on the completed Pan-American Exposition weather map by 12 noon of the same date.

(c) *Printing press and accessories.*—For the printing of the above-described souvenir map the Weather Bureau is especially indebted to Messrs. Walter Scott & Co., Plainfield, N. J., who kindly loaned for the purpose the very handsome and complete two-color lithographic press, shown in Plate II. This is operated by a special 5-horsepower electric motor, constructed and loaned by The General Electric Company, of Schenectady, N. Y. Proof presses and all the necessary ap-

pliances for lithographic work are installed in this section, and the complete and special processes employed by the Bureau in preparing and transferring meteorological data to stone, and in the printing of weather maps therefrom, are conducted in full view of all interested visitors.

(d) *Folding machine.*—The large size of the map makes it essential that it be quickly and neatly folded for mailing or distribution, and a folding machine was arranged especially for this purpose and courteously loaned to the Bureau by the Dexter Folder Company of New York. This ingenious and useful machine is clearly shown near hand railing in front of press in the illustration, Plate II.

Souvenir envelopes printed in colors, showing the national ensigns of some of the more important American republics, together with cuts of storm and weather flags in daily use by the Bureau, were prepared for holding and facilitating the distribution of the maps. The maps are also posted daily in suitable frames conspicuously located in the more important buildings and thoroughfares on the Exposition Grounds.

(e) *Telephones: city and local.*—To facilitate the prompt receipt of weather reports, data for the maps, the daily forecasts, etc., and for the distribution of special warnings, the exhibit is fully equipped with both city and local telephones. By means of the latter and an exchange located on the grounds, all the more important buildings and exhibits of the Exposition can be promptly reached.

The exhibit is in charge of Mr. David Cuthbertson and a corps of assistants who have had many years' training and experience in the meteorological work of the Bureau, and they take pleasure in explaining the instruments, apparatus, etc., to all interested visitors. An effort has been made to make this very complete working exhibit of especial interest to the hundreds of voluntary observers of the Weather Bureau who will probably visit the exposition, and it is hoped that it may have a passing interest, at least, to all others who may see it.<sup>1</sup>

<sup>1</sup>The illustrations accompanying this article were obtained through the courtesy of Mr. Harry H. Brigham, Assistant Representative in charge of the Exhibit of the United States Department of Agriculture, and Mr. David Cuthbertson, Forecast Official in charge Weather Bureau Exhibit. This favor, the many timely suggestions, and the cordial assistance rendered me by these gentlemen in the arduous work of installing our exhibit are gratefully appreciated.—D. T. M.

## NOTES BY THE EDITOR.

### HAIL AND THUNDERSTORMS IN OREGON.

Notable thunderstorms and hail occurred at Springfield, Lane Co., Oreg., 44° 5' north; 123° west, and at Aurora, Palmer County, 45° 16' north; 122° 50' west. Springfield is in the valley of the upper Willamette, and Aurora is not far from the Willamette in the lower portion of its course. The following items are taken from special reports addressed by Climate and Crop correspondents to Mr. E. A. Beals, Forecast Official and Section Director at Portland, Oreg.

At Springfield Mr. J. S. Churchill says:

Saturday, May 25, 1901, was quite warm and sultry. At 2 p. m. a black cloud formed in the southeast and moved slowly in a northwest direction. Shortly afterward a similar cloud formed in the southwest and moved in a northeasterly direction. About 4 p. m. these two clouds were merged into one, moving violently over the country in a westerly direction accompanied by thunder, lightning, and hail. Hailstones, many of which were 1½ inches in diameter, fell thick and fast for a period of ten minutes, along with a deluge of water. The main storm of hail began at a point about seven miles east of the town of Springfield, and covered a space of from three to five miles wide and from seven to ten miles long. Near the center of the end of this path the wind developed to hurricane force, uprooting and breaking off trees three feet in diameter. Such a hailstorm has never been experienced before by the writer during his fifty years residence in Oregon.

Mr. J. C. Brattain, also of Springfield, says:

The hail extended over about six or seven miles in length and four in width. The stones were from three-quarters to one inch in diameter, but occasionally 2 inches; there were narrow strips in the storm's course from southeast to northwest where it was especially severe.

Mr. Charles J. Dodd, of Springfield, states that he rode over and examined a large portion of the area affected by the hail, and finds that the afternoon was quite warm, viz, temperature about 70° F., with a gentle breeze from west-northwest. Three distinct thunderheads made their appearance about 3 p. m. One formed in the coast range west of Cottage Grove, and drifted northeasterly, another formed near Diamonds Peak in the Cascade range, and drifting rapidly northwest, followed the Willamette River. The third began west of the Three Sisters and drifted almost due west. At 3:30 p. m. these three clouds met about half a mile south and west of the town of Springfield. Here the destruction was greatest, and the width of the storm at this point was about two miles. It became suddenly very cool, the temperature fell to 45° F., the wind changed to southwest and the cloud swept toward the north or northeast. The total length of path was about sixteen miles with an average width of two miles. The damage done by the hail was between \$10,000 and \$20,000, while the size of the hailstones varied from one-fifth to two and one-half inches in diameter; in many cases two or three of these were frozen together; near the center of the track the average size might be compared to large sized English walnuts.

With regard to the storm at Aurora, Mr. G. Muecke reports as follows:

An extraordinary phenomenon of thunder and lightning occurred last night, which is of such rare occurrence in this region that the oldest inhabitants assured me to-day that they never experienced anything like it, some of them having lived around here since 1845.

Last evening at about 10:25, distant horizontal flashes of lightning commenced at the southeast, temperature 63°; no thunder was audible and the lightning was frequent, extending over a long range from extreme southeast to nearly east. This continued until after 11:15 p. m., when I retired. No doubt this must have continued further, for at 12:20 a. m. I was awakened by roaring thunder. Getting up at once, I watched the southeast and east horizon, which I viewed from this station, as formed by the Cascade Mountains, just about 50 miles distant.

Such intense flashes of lightning, illuminating the sky and country to the extent of almost bright sunlight, I have never before seen. What seemed to me very strange, however, was the fact that not once did the streaks of lightning form zig zags like those seen by me in the East and in Europe, in my youth. Last night's flashes were all vertical and inclined about 10° down to points either just west or just east of the Cascade Range. The streaks of lightning were mostly like half a spiral or corkscrew. But three times I saw a perfect "n" and once an "m." The thunder peals which followed were tremendous. I must remark that for half an hour I invariably counted intervals of from twenty to twenty-three seconds elapsing between the lightning and the thunder; for over half an hour the flashes occurred regularly every twenty-five to thirty seconds. The rain here during two hours amounted to only 0.29. At 1:15 a. m. the phenomenon ceased. The entire storm lasted two hours and fifty minutes, the longest continuous lightning and thunder I ever experienced.

#### METEOROLOGY IN FRENCH INDO-CHINA.

We copy from the *Annales de Géographie*, March, 1900, IX, p. 178, the following paragraph which shows that meteorological observations are now well established in a portion of the world from which we have hitherto received very fragmentary information.

For a long time past we have regretted the almost complete absence of meteorological observations in French Indo-China. This gap was especially to be lamented, from a scientific point of view, because it prevented us from extending our studies over one of the most interesting portions of Asia and, from a practical standpoint, because a knowledge of the climate is of primary importance for hygiene, colonization, and the rational utilization of the soil. The Central Meteorological Bureau of France had several times opened negotiations with the successive governors of Indo-China for establishing an adequate network of meteorological stations in that immense region, and the project was for a short time on the point of being realized by M. de Lanessan, when the latter was obliged to leave our colony. The project has just been revived and brought to a happy conclusion, thanks to the enlightened initiative of the present Governor-General M. P. Doumer.

The network of stations for the year 1900 has been constituted as follows, the principal stations being printed in capital letters:

In Cochinchina: SAIGON, CAPE SAINT-JACQUES, POULO-CONDORE, Ong-Yem, Tay-ninh, and Soc-trang.

In Annam: NHA-TRANG, LANGSA, TOURANE, Quin-hone, Hué, Dong-Hoi, Vinh, and Than-hoa.

In Tonkin: HANOI, Haiphong, Quang-Yen, Hon-gay, Mon-cay, Lang-sou, Cao-bang, Lao-kay, Ha-giang, Bac-kan, and Van-bu.

In Laos: VIEN-TIANE, Luang-Prabang, Savannakhek, Khong, and Attapeu.

In Camboge: PNOM-PENH, Kampot, and Pursat.

In Yunnan and China: YUNNANSEN, Semaio, Mongtze, Lang-tchéou, Pakhoi, Hoi Hou, Kouang-Chau-Wan (Kouang-tchéou Ouan).

In the Gulf of Siam: Chantaboun, Bangkok, and Singapore.

To these stations will be added a first class observatory, which will probably be established near Haiphong and where regular magnetic observations will also be made. All the scientific outfit of this observatory is due to the well-known liberality of M. Bischoffsheim; the greater number of these instruments have just been sent there.

It will thus be seen that this network of stations has been well conceived and very interesting results may be expected from the observations that have just begun to be made there. There are only two other things to be wished for, viz, that the new establishment may be permanent, and that on the other hand the means may be found for publishing the observations regularly—the only means of rendering them really valuable.

#### A RAIN OF SMALL FISH.

Mr. J. W. Gardner, voluntary observer at Tillers Ferry, S. C., reports that during a heavy local rain about June 27 there

fell hundreds of little fish (cat, perch, trout, etc.) that were afterwards found swimming in the pools between the cotton rows in a field belonging to Mr. Charles Raley.

It is a well-known fact that in such rains all sorts of foreign objects, whether sticks or stones, frogs or fish, or even debris of destroyed houses and crops, occur occasionally not only in America but in Europe and elsewhere. It is very rare that we are able to trace these objects back to their sources, but there can be no reasonable doubt that they were carried up from the ground by violent winds, such as attend thunderstorms and tornadoes. Light objects, such as sheets of paper, have been identified as falling at points twenty or fifty miles distant from their starting point, but it is hardly likely that heavier objects, such as fish, could be carried so far without coming to the ground.

#### SUN SPOTS AND METEOROLOGY.

The question as to a possible relation between sun spots and terrestrial meteorology seems to have been started by Riccioli in 1651, as soon as physicists and astronomers fairly began to follow in the footsteps of Galileo. In 1800 Herschel suggested a relation between sun spots and the crops as depending upon the temperature of the earth. The memoirs of Fritsch, Vienna, 1854; Gautier, 1844; Arago, 1855; Zimmermann, 1856; Wolf, 1859, represent about all that was known on the subject before 1870.

In 1869, by comparing Wolf's sun-spot figures with various meteorological tables, I satisfied myself that the variations of solar radiation affect the terrestrial temperature so slightly that they are generally marked by local climatic peculiarities, but a special study of the observations on the summit of the Hohenpeissenberg near Munich (see *American Journal of Science*, 1870, vol. 50, p. 345) showed that the daily 2 p. m. observation gave a clear indication of the direct heating power of the sun and that the midday air temperature decreased at the rate of 0.008° R. for each unit of Wolf's tabular sun-spot numbers. There was also an indication of a period embracing about five sun-spot periods or 55.5 years, and a further possibility that the periodic changes in spots may have to do with planetary tides in the solar atmosphere.

Dates of maximum and minimum temperature.		Dates of maximum and minimum sun spot.
In the Tropics.	Beyond the Tropics.	
.....	1815 5	1816 8*
1823 5*	.....	1823 2
.....	1825 8*	.....
1830 1	.....	1829 5*
.....	1831 9	.....
1833 1*	.....	1833 8
.....	1834 2*	.....
1836 4	.....	1837 2*
.....	1837 8	.....
1842 8*	.....	1844 0
.....	1846 4*	.....
1847 6	.....	1848 6*
.....	1850 3	.....
1854 7*	.....	1856 2
.....	.....	.....
.....	1861 6	1860 2*
.....	.....	1867 2
.....	1868 7*	.....

\*The maxima are indicated by the star.

Koeppen states that at that same time he began collecting his material for an investigation on the broadest possible foundation, the results of which he published in the *Meteorologische Zeitschrift*, 1873, Vol. VII, pp. 241 and 257. He collated all available series of observations at stations embracing three years or more of continuous work and wove them into a homogeneous system of groups, twenty-five in all, representing the years 1731-1871 and covering the whole